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Journal of the Society of Arts.

FRIDAY, NOVEMBER 24, 1865.

Announcements by the Council.

ORDINARY MEETINGS.

Wednesday evening, at Eight o'clock:—

NOVEMBER 29.—" On the Proposed Purchase of Railways by the Government." By WILLIAM HAWES, Esq., F.G.S. On this evening Lord Lyttelton will preside.

DECEMBER 6.—" On the Graphotype, a Process for producing from Drawings, Blocks for Surface Printing." By HENRY FITZ-COOK, Esq. On this evening Henry Cole, Esq., C.B., will preside.

DECEMBER 13.—" On London Milk." By J. CHALMERS MORTON, Esq.

DECEMBER 20.—" On Parkesine, its Composition, Manufacture, and Uses. By OWEN ROWLAND, Esq.

CANTOR LECTURES.

The Cantor Lectures for the present Session will consist of Three Courses, to be delivered by G. W. HASTINGS, Esq., LL.D., Barrister-at-law; FLEEMING JENKIN, Esq., F.R.S.; and Dr. F. CRACE CALVERT, F.R.S.

The following are the particulars of Mr. Hastings's course:—

LECTURE I.—MONDAY, NOVEMBER 27TH.—" The Effects of the Discovery of the Precious Metals on the Ancient Civilisation of the Mediterranean."

LECTURE II.—MONDAY, DECEMBER 4TH.—" The Effects of the Discovery of the Precious Metals on Modern Civilisation.

LECTURE III.—MONDAY, DECEMBER 11TH.—" On Copyright."

LECTURE IV.—MONDAY, DECEMBER 18TH.—" On Limited Liability."

The other courses will be " On Submarine Telegraphy," by Mr. Fleeming Jenkin, and " On Novel Applications of Chemistry to the Arts," by Dr. F. Crace Calvert.

The lectures will commence each evening at Eight o'clock, and are open to Members, each of whom has the privilege of introducing ONE Friend to each Lecture.

Proceedings of the Society.

SECOND ORDINARY MEETING.

Wednesday, November 22nd, 1865; William Odling, Esq., M.D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Allen, Matthew, 61, Tabernacle-walk, E.C.
Barfoot, Edwin, 32, St. Martin's-le-Grand, E.C.
Barry, Herbert, 57, Old Broad-street, E.C.
Bowker, James, 1, Gray's-inn-square, W.C.
Brook, William Pitt, 1 and 2, Poultry, E.C.
Brooks, William Cunliffe, 81, Lombard-street, E.C.
Brown, John, 15, Rolls-buildings, Fetter-lane, E.C.
Carttar, C. Graham, 7, Skinner's-place, Sise-lane, E.C.
Dawnay, Archibald Davis, 58, Campbell-road, E., and 11, Park-street, Westminster, S.W.
Dickinson, George Francis, 17, Gracechurch-street, E.C., and Farleigh House, Surbiton, S.W.
Dornbusch, George, South Sea House, Threadneedle-street, E.C.
Evans, Charles John, 5, Princes-street, Bank, E.C.
Harris, Rev. Charles, Summer-town, Wandsworth, S.W.
Hart, John Walter, 60, St. Mary Axe, E.C.
Harwood, Edward, jun., 33, Abchurch-lane, E.C.
Hellaby, Joseph, 122, Wood-street, E.C.
Henshaw, William, 2, Sun-street, Bishopsgate, E.C.
Hibbert, Edward, 7, Jewry-street, E.C.
Langton, Rivers, 15, Laurence Pountney-lane, E.C.
Masters, Joseph Reynolds, 78, New Bond-street, W.
Morley, Henry, 4, Frederick-villas, East Brixton, S.
Nash, Alfred George, 13, Basinghall-street, E.C.
Nickisson, John Charles, 16, Watling street, E.C.
Overend, William, Q.C., 6, Queen's Gardens, Hyde Park, W.
Parker, Josiah, 44, St. Paul's Church-yard, E.C.
Price, Frederick Wakefield, 31, Upper Seymour-street, W.
Smith, S. T., Rivers Commission Office, 2, Victoria-street, S.W.
Vernon, Hon. A., Sudbury-hall, Derby

The Paper read was—

ON WATER SUPPLY, ESPECIALLY TO SMALL TOWNS AND VILLAGES IN RURAL DISTRICTS.

By J. BAILEY DENTON, Esq., Memb. Inst. C.E.

(Hon. Memb. Royal Agricultural Soc. of Hanover, and Principal Engineer to the Land Drainage and Improvement Company.)

When it was suggested to me to read a paper on this subject, it was at the close of September—perhaps the driest month on record—and at the end of a dry summer, following another drier still, in which the whole country had suffered from drought. The suggestion appeared to be so opportune that I did not hesitate for a moment in acting upon it. Since that time we have experienced the wettest month (October) it has fallen to my lot to record since I have been an observer of rainfall. This coincidence would have made me hesitate in bringing the subject before the Society, were it not that it aptly bears out one of the principal views I am about to advance, for to talk of the want of water, or to speak of water in any shape, immediately after experiencing the discomforts of excessive wetness, is to introduce my subject under forbidding circumstances. It may, therefore, be better to preface my observations by stating that the remedy for the present objectionable condition of the water supply of our small towns and villages in summer, which I am about to recommend, is the storage of water discharged in winter; and the appositeness of the great downfall of rain in October will be apparent when it is pointed out that if the quantity which has been allowed to run to waste during that single month, in the Midland and South-Eastern counties, had been stored for the use of next summer, the quantity collected would have alone afforded sufficient provision against a repetition of drought.

Observers of meteorology know well that it is not the fall of rain that expresses the amount of water capable of storage, unless it be in exceptional instances, where the surface is exposed rock with steep inclinations. Evaporation and surface vegetation during spring and summer take to themselves a very large share of the rainfall, leaving little or none for other appropriation; whereas in autumn and winter, when these natural agencies are comparatively dormant, the reverse takes place, and in some months nearly all that falls is discharged from the surface into the rivers or absorbed by the earth. It is therefore quite possible to have a very dry summer with a rainfall above the mean quantity, if the number of wet days are comparatively few, and the general hygrometrical condition of the atmosphere such as to promote evaporation. The last seven months (from the 1st April to the 31st October) will serve to exemplify this effect very clearly.*

In the early months of April and June we had very little rain, and very few days on which rain fell, and vegetation being then in full vigour, and evaporation active, there was drawn from the ground very much more moisture than was deposited upon it in rain and dew. The quantity of rain, however, that fell in the intervening month of May being quite up to the average, counteracted, to some extent, the deficiency of April and June. In July and August the rain was above the average, being increased by several heavy falls during thunder storms, but such was the parched condition of the soil, and the thirsty state of vegetation, that the rain which rested on the surface was quickly absorbed and appropriated, while that which passed off replenished the ditches and ponds, and so furnished the poor of our rural districts with water, which they otherwise would not have had.

Thus partially replenished, we reached the month of September, in which there was literally no rain whatever in several of the South-Eastern counties, the only deposition of wet or moisture being dew, which was so heavy as to amount in some days to one ton weight and more per acre, an amount which admitted of being measured in the rain-gauge and recorded.

The total quantity of rain that fell on the eastern side of England, between the 1st April and the 30th September inclusive, may be illustrated by the following cases:—At York the fall of rain was 10·7 inches, of which 5·3 inches fell in 19 days in August, and the remaining 5·4 inches was spread over 164 days. At Diss, in Norfolk, the quantity that fell was 12·4 inches, of which 9·3 inches fell in 30 days in July and August, and the remaining 3·1 inches in 153 days. At the Royal Observatory, Greenwich, the fall was 13·7 inches, of which 8·4 inches fell in 30 days in the months of May and August, and the remaining 5·3 inches in 153 days. These figures, as divided, will explain how it has been that, with more than an average fall of rain, we have had a dry summer.

If we turn to the West of England—that part of the country which has generally been supplied with rain in the proportion of 3 to 2—we find the rainfall of last year very little exceeded that of the east. It will be apparent, therefore, that the views and deductions about to be advanced will apply to the west as well as to the east, though in a less degree.

The quantity of rain that fell at Carlisle in the six months from 1st April to the 30th September was 12·4 inches. of which 8·7 inches fell in 35 days, and the remaining 3·7 inches in 148 days. At Manchester the total fall was 13 inches, of which 10 inches fell in 54 days, and the remaining 3 in 129 days. At Helston, in Cornwall, the quantity which fell during the six months was 15·4 inches, of which 9·7 inches fell in 35 days, and the other 5·7 inches in 148 days.†

This was the condition of the country when the rains of October set in. The total quantity of rain which fell in this month will, of course, have varied with different localities, and it will be especially observed, when the records are examined. that the rainfall in the south and east of England exceeded that of the north and west very considerably, and to a degree I believe never before recorded.

In Sussex the quantity that fell reached 11 inches, in Hertfordshire about six inches, in Suffolk about seven inches, and in Cornwall about eight inches; while in Lancashire it hardly reached five, and in Chester barely four inches.

Thus it will be seen that in one month, in which there were not more than 26 rainy days, the amount of rainfall was more than half the rainfall of the previous six months; and this large supply, it should be clearly remembered, was given us, not when vegetation was on the ground to seize it, and evaporation active to wrest it from us, but when harvest had cleared the ground of the crops, and the atmosphere was charged with moisture, leaving nearly the whole of the quantity at our disposal if we had only taken the pains to intercept it.

It must occur to all who may think on this subject that the drought, which has been repeated for two summers, may occur again with equal if not increased effect, and the reflections which will arise to the mind in contemplating the sudden and copious supply with which we were replenished last month, cannot fail to suggest a remedy, even to the uninitiated in water questions.

The little I have said on the subject of rainfall must have shown how advantageous it would be if the country possessed a thorough system of recording rainfall and evaporation under proper authority, based upon equidistant stations of observation, and not dependent on the spasmodic efforts of private individuals.

As an illustration of the truth of this remark, I believe I am right in stating that within these last two or three years the fall of rain on the Snowdonian range in North Wales has been discovered, by the efforts of Captain Mathew, of Wern, near Portmadoc, to be very considerable, forming, in fact, a source of supply which no one knew had existence. By a series of observations taken by Captain Mathew it is seen that in the past summer the rainfall of the region referred to amounted to 50 per cent. more than the greatest rainfall in any place of which records are published by the registrar-general.

If Captain Mathew's figures were compared with the rainfall of the lake district of Cumberland, there would, I presume, be but little difference between them; and when it is remembered that Liverpool, after spending immense sums of money in storage reservoirs, and wells, is without a proper quantity, that Chester possesses a very inferior supply, and that Birkenhead is dependent upon wells alone, the information supplied by Captain Mathew, though late in the annals of meteorological science, will be acknowledged to be of a most valuable character. When speaking of the deficiency of correct data, let me take this opportunity of expressing the obligation the public are under to Mr. G. J. Symons for his great industry and perseverance in organizing the best series of observations in the power of a private individual.

It is the opinion of many that various circumstances are at work to lessen the rainfall of this country, and to interfere with the influences which have hitherto prevailed, and there is doubtless much to support this view. Drainage in all its forms (agricultural or underdrainage, arterial or district drainage, and the drainage of towns), the better and deeper cultivation of the soil by steam ploughing and stirring, and the clearing of woodland and worthless hedgerows, all help to reduce rainfall; and the multitude of railways which characterise localities may have the influence Mr. Glaisher attributes to them, of attracting downfalls under certain conditions of the atmosphere. But the sea-girt position of this

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* Some very remarkable facts will be observed in the meteorology of the present year when compared with the last and former years. The prevalence of east wind compared with that from the west has been about double the proportion generally due to it, and the same remark will apply to the quarter from which the rain came.

† It may be interesting to compare the various summer rainfalls quoted above with the rainfalls of last year and the mean falls of former years:—

RAINFALL OF THE SIX MONTHS FROM 1ST OF APRIL TO 30TH SEPT.

	1865.	1864.	Mean rainfall for several years.
	inches.	inches.	inches.
York	10·7	10·0	13·3
Diss	12·4	6·8	9.9
Royal Observatory	13·7	7·9	13·2
Carlisle	12·4	11·6	13·9
Manchester	13·0	15·8	17·7
Helston	15·4	9·3	15.35

country prevents a deficiency from being injuriously felt, for we have always close at hand an inexhaustible supply in the Atlantic Ocean, the North and Irish Seas, and the English Channel, from which the atmosphere can supply itself with moisture to any extent.

When admitting that the improved agricultural condition of the surface of the land owing to superior husbandry may be lessening the rainfall, though in an inappreciable degree, it is desirable to remove, if possible, the impression prevailing in the country that land drainage is helping to diminish the quantity of water discharged into our rivers. Nothing can be more erroneous than this view; the effect of all drainage is to increase the water discharged from the surface of the soil, but, unfortunately, it is discharged, not in summer when we want it, but in winter, when we have more than we want; and when in its way to its ultimate destination, the sea, it often causes floods and damage to the lower lands and towns which exist on the banks of the rivers by which the accumulated waters pass away.

If we acknowledge that the object aimed at in all works of drainage, particularly under-drainage, is to discharge the excess, which would otherwise stagnate on the land and keep it in a state of saturation until it eventually passed off by evaporation, it is clear that the quantity discharged is so much given to the rivers instead of to the atmosphere. The effect of underdraining is to make the land absorbent, and allow the rain that falls on its surface to pass down into the soil, which yields up to the drains any excess that may exist, after the retentive properties of the soil are satisfied. But it must not be supposed that this water descends from the surface of the land directly into the drains, as I am sorry to say many people think, but that it descends into the earth, and, having satisfied the demands of the soil, rises to the general level of the drains, when the excess passes away by them. The popular notion, that drains are placed in the ground to catch the descending rain cannot be too soon removed; they are placed in the land to carry off that which would rise to the surface itself, were it not that the force of gravity is brought into action by the existence of the drains, which become so many channels for the discharge of the excess which the soil cannot retain.

It is stated by many, too, that the springs which found vent at the surface of the ground before drainage are eradicated and lost by under drainage; but this is not so; on the contrary, though removed out of sight, they are increased in volume. Before draining, the water which formed these springs rose to the surface, and was exposed to the sun and wind. The result was that a large proportion was dissipated by evaporation; whereas drainage prevents the springs rising to the surface, and thus lessens evaporation, whereby the flow of water through the drains is increased by the portion rescued from the atmosphere.

Thus it will be seen that though the quantity of water evaporated from the surface is reduced by drainage, and thereby the source of rainfall proportionately weakened, the result is to augment in its aggregate quantity the discharge into the rivers. If the general effect of under-drainage is to increase in an irregular manner the water supply, there are points bearing upon our water economy which should have effect in governing the mode in which the works are carried out. It is not desirable to enter upon the mode in which drainage should be performed, but it is very desirable that it should be understood that the rate at which water is discharged from the land depends upon the nature of the drainage works. In under-drainage it depends upon the number of drains put into the soil; and in certain soils, if a greater number are adopted than are absolutely necessary for setting the water in motion, not only do they operate to the serious derangement of the river systems, but to the detriment of the productive powers of the land itself. There is not a shadow of doubt that much land of a free character is being drained by a uniform system of parallel drains, which, if differently treated, would be capable of advantageously sustaining instead of injuriously deranging the water supply—and this, too, with a better effect upon the productive capabilities of the land itself. It does not require an engineer nor an agriculturist to understand that clay lands should be drained in a different way to wet gravels and sands. A very large portion of the gravels and sands of this country are as wet as the clays, and are capable of becoming, by appropriate treatment, storage reservoirs themselves, to give out a good supply of the best of all water during summer, whereas, if they are to continue to be threaded and netted by drains, as they are now, the water hitherto stored by them will be discharged with increasing effect as drainage extends, attended by greater and more serious derangement of our river systems.

These remarks apply to under-drainage. There is another branch of drainage which, though at present affecting the water supply of rural districts in but a slight degree, will, as examples become more numerous, affect it very greatly. Our country is divided into numerous water sheds, drained by rivers, which flow down the main valleys, and are fed by tributary streams in minor valleys within the same watershed. Many of these minor valleys are water-logged, and some few of them have already become the scene of operations, under the Drainage Act of 1861, by which they have been formed into drainage districts, and are discharging or are about to discharge the water which lodged in them with instant effect upon the main valleys below.

This is the object for which districts are formed. Before drainage, the water-logged valleys performed the part of so many reservoirs, feeding the atmosphere by evaporation, and the rivers by slow percolation, through the summer; now, after drainage, the water being discharged in winter as quickly as possible, it overloads the main channel and collects in the lower valley, and not only does injury there, but interferes with the *régime* of the main rivers. Still, the drainage of such valleys is so beneficial and so profitable that it will proceed in spite of the difficulties; and it need not be repeated that the water thus discharged in winter, when it is injurious, is capable of being turned to use in summer when it is wanted.

It is not the object of this paper to dwell with any detail upon the sources upon which our perennial supplies, *i.e.*, our main rivers and deep wells, depend. All supply is gained primarily from the rainfall. The subterranean waters which find outlet by springs at the outcrop of different strata, and sustain our rivers and deep wells, are all fed from the surface by rain which descends during the winter months—from October to March inclusive—when, as already mentioned, the demands of evaporation and vegetation are at a minimum. If the winter rains are less than the average, the subterranean supply is lowered in proportion, particularly if dry and hot summers intervene to cause an excess of evaporation.

For the last three winters we have been deficient in rainfall in several of the more important quarters of England, as will be seen by the following statement furnished by Mr. Symons; and it is a well-known fact that in those quarters the deep wells were never so low as at the present time. If the rainfall of the coming winter should not be sufficiently above the average to make up for past deficiency, the sequence of comparatively dry winters and summers, which have occurred since 1861, will tell with great force. (See Table, p. 20).

The extent to which a succession of reduced rainfalls in winter act upon the springs and deep wells, is a subject to which I have recently given some attention, and I hope at some future time to publish the results. At present I can only state that measurements of wells, in the water-bearing strata, indicate with reliable accuracy that a succession of reduced rainfalls in

ENGLISH WINTER RAINFALL.

	York ... ... { above ground, 6in. above sea level, 50ft.				Wigston, Leicestershire... { above ground, 6in. above sea level, 220ft.			
	1862–3.	1863-4.	1864–5.	Mean of 20 years.	1862–3.	1863–4.	1864–5.	Mean of 10 years.
October	2·80	3·13	2·57	2·49	2·91	3·07	1·66	2·93
November ..	·83	1·85	2·45	1·99	·90	2·04	2·19	2·43
December.. ..	1·35	1·59	2·52	1·46	1·65	1·11	1·42	1·63
January	2·81	·82	1·07	1·72	2·88	·88	2·33	2·14
February	·51	1·15	1·55	1·30	·48	1·71	2·43	1·21
March	1·11	1·78	1·18	1·35	·63	2·42	1·01	1·38
	9·41	10·32	11·34	10·31	9·45	11·23	11·04	11·72

	Orleton, Tenbury, Worcestershire ... ... { above ground, 9in. above sea level, 200ft.				Goodamoor, Plymouth, Devon { above ground, 2in. above sea level, 580ft.			
	1862–3.	1863–4.	1864–5.	Mean of 20 years.	1862–3.	1863-4.	1864–5.	Mean of 20 years.
October	4·14	4·09	2·23	3·17	10·64	8·33	2·65	5·91
November ..	1·20	2·52	2·36	2·60	2·10	4·70	6·51	6·40
December.. ..	2·08	1·47	2·33	2·09	6·24	5·85	4·71	5·17
January	3·48	1·31	2·58	2·42	6·92	4·24	7·58	5·93
February	·82	1·73	2·66	1·67	2·59	3·51	5·68	4·11
March	1·11	2·51	1·13	1·79	3·56	2·93	3·91	5·11
	12·83	13·63	13·29	13·74	32·05	29·56	31·04	32·63

winter, with intervening hot summers, lower the supply beneath, and that any increase of fall in the summer does not raise the water level in any sensible degree.

This fact and the experience gained in the use of deep wells, viz., that the increasing demand for water has already permanently lowered the water level in certain water-bearing strata, must have the effect of rendering such source of supply a doubtful one, and one of which the cost will increase as the wells multiply, so as to exclude their use for small towns and villages where economy is the first consideration.* Many large towns, however, are now supplied by wells in the new red sandstone with excellent water; others by wells in the chalk and oolitic bands with water not free from objection.

It has already been shown that the effect of drainage is to reduce the flow of rivers in summer and augment them in winter. It will presently be seen, when treating of the increasing demands for water during summer, that circumstances conduce to depreciate the quality in an irresistible degree. It will suffice here to remark that all things are tending to the discontinuance, as a general rule, of the use of rivers as a means of supply of water for domestic purposes, although many large towns are dependent upon them. In exceptional cases tributary streams supply excellent water without any detracting effects; and springs taken at their source will always form envied objects by those who are seeking supplies for large towns, but they are seldom to be taken with impunity, for the simple reason that rivers are sustained by them.

Now let us consider to what extent water is used for social, agricultural, and commercial purposes; and how far those objects are likely to operate at that period of the year (summer) when the supply is least. We know from the published census the rate at which the population has increased, but we have no statistics by which we can arrive at the quantity of water used for household purposes, in contradistinction to the various ways in which it is consumed—in the factory, the steam-engine, the road, the farm, and the garden. As the population increases, the quantity supplied to each unit becomes greater too. With increasing cleanliness, water-closets are introduced into all places, and our smaller towns and villages are rivalling the larger towns and cities in the adoption of those comforts which necessitate an increased supply of water. As the weather gets warmer, and the natural supply less, the demand increases everywhere. The extended use of steam in manufactories, on railways, in the cultivation of the land, and in the duties of the farm homestead, and the use of water in watering roads and gardens, increase the demand, and, in the aggregate, swell it to a very large amount.

While the use of water is extending and the summer supply becoming less by reduced rainfall and by the operations of man on the surface of the earth, to what extent are our rivers and streams being polluted? Is it not a fact that the water we apply to our household purposes is returned into the rivers no longer as water but as sewage? This system of exchange is going on throughout the country, and, in spite of all efforts to prevent it, there does not appear to be any power to exclude from our rivers the liquid refuse of the surface. In fact, the most natural view that can be taken of the use of rivers is as the drains of the country through which they pass, for, although in the aboriginal state of the country, rivers were capable of supplying water for all the purposes for which it was then required, the condition of the country is so altered by increasing population and trade, that it is not a question whether the rivers should answer the combined purposes of supplying water and removing refuse, but how they can best serve their normal purposes as drains, and drains only.

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* The Rev. J. C. Clutterbuck, in his recent article on "Water Supply," in the Royal Agricultural Society's *Journal*, when speaking of the chalk stratum states the depression under London to amount to sixty feet: and it is a fact well known that some of the largest establishments in London using the water from the chalk are obliged to accommodate one another by pumping on alternate days, that their labour may not be wasted.

It is not to be supposed from this remark that there are not some rivers which may still be maintained to all time as the sources from which to obtain water for all purposes, but these are the exception and not the rule; nor must it be supposed that we are to abandon the rivers to all the filth that may be poured into them, by which their limpid character shall be lost as one of the great charms of our rural scenery, but, it must be understood to mean that, though the rivers may be brought into an inoffensive condition capable of supporting fish, they cannot, as a rule, be made sufficiently pure to supply water to human beings.

It may appear presumptuous to speak so emphatically upon a matter on which so many opinions do and will exist, but when it is mentioned that all that has yet been practically done in the way of purifying sewage has failed to do more than separate the solid from the liquid, leaving the liquid as noxious as before, the presumption will not appear so great. Science may eventually discover some means of appropriating the fertilizing gases of sewage, which, when once mixed with water, according to our present knowledge, are inseparable from it. When that time arrives, a somewhat different view of the matter may be taken, but under any circumstances the principal purpose of rivers will remain the same, and the liquid refuse, after utilization, must find its way into them, and therefore will necessitate their being maintained as drains.

The shifts to which towns are already reduced in order to obtain water and discharge their refuse at the same time may be appropriately illustrated by an instance, the particulars of which can be verified. The case is that of Tunbridge Wells, in Kent. I especially select that town because it is one of modern existence, and therefore fairly illustrates what may arise in other places where no towns exist.

Tunbridge Wells is now a large town abounding in first-class houses; indeed it is hardly possible to mention any town containing the same proportion of superior dwellings. These houses are furnished with water-closets, and all the refined appliances requiring a large supply of water. To furnish that supply has been a very difficult matter. In the first instance the springs,—which burst out on the present site of the town, and flowed by a small channel into the Medway (some five miles off), providing the population along its banks, such as it was, with excellent water,—were intercepted at their head, and appropriated for the purpose. This water, after serving the houses, for which it was abstracted, was returned in its polluted state into its old channel, and thus it flowed to the Medway a foul and corrupted sewer. So sensible were the landowners at Tunbridge Wells of the value of the springs they had appropriated that, for fear they might be affected by any operations on the part of those to whom land was sold or let, covenants were introduced into deeds of sale or lease, prohibiting the parties from dealing with the property in any way that could affect these springs. The supply so secured and protected is now found to be insufficient, and last year the authorities applied to Parliament for powers to extract springs from lands some distance away, and thereby absorb streams not in the valley of which Tunbridge Wells is the head, but in an adjoining valley, from which the water, when taken, will have to be raised over interposing high ground to a supply reservoir near Tunbridge Wells.

Thus has one large town not only converted a clear stream into a dirty sewer, but it has obtained parliamentary power to take the water it requires from another stream, and deprive the valley through which that stream flowed of any prospective value attached to a good and copious flow of water. Doubtless, an engagement has been entered into to maintain the quantity of water at present used by the people living in the valley so treated, but all future and prospective benefit is taken away, because there exists in one place a power sufficient to do it, and in the other an incapability to resist it. This case of Tunbridge Wells is cited because there is no reason to believe that what has taken place there may not occur in many other places.

Last year an effort was made by the authorities of the town of Cheltenham to extract springs, which were some of the sources of the river Thames; and, had it not been that the Thames was a metropolitan river, there is no doubt that the evil would have been consummated, and the villages and smaller places would have raised their voices in vain. This compound system of injury, first, in taking the water from poor districts to supply the rich; and next in giving them in return the discharged sewage, will of necessity be partially remedied, for it is altogether against public justice that such a system should remain unabated. But it must not be imagined that a modification which extends simply to the separation, by processes of deodorisation and filtration, of the solid matter from the liquid sewage, so as to allow the latter to pass away clear into the river, or that surface-irrigation, will restore purity.

A single instance will illustrate this, and the case of Barnard v. Arkwright will serve very well for the purpose. The plaintiff, Mr. Barnard, was a farmer, using the Harlow Brook, in Essex, as a watering place for his horses and neat stock. Into this brook the washings of the kennels of the Essex hounds were discharged. The washings were particularly objectionable, because it was found, in certain instances, that the dogs had been fed upon horses that had been glandered, and that the skins of the dogs were occasionally washed with arsenic, so that two poisons found their way in some shape or other into the brook. It was stated by the plaintiff that his horses and cattle had been killed by drinking the brook water, which the defendant denied, and an action was therefore brought. The case was tried, and the Court made an order that the objectionable refuse should not be discharged into the brook.

The master of the hounds, upon receiving the order, set to work to filter and precipitate the refuse, and, having made it clear, assumed that he had obeyed the order. The tenant in question did not concur in this view, and I was directed by the Court to see if the order had been obeyed. When I visited the spot, the filtered liquid was perfectly clear, but, suspecting that it might still be obnoxious, I obtained the assistance of Dr. Voelcker to analyse it, and he took several bottles of the clear water away with him to his laboratory at Cirencester. The water was left in the corked bottles for a few days, but when at length the Doctor opened them, in the presence of his pupils, to perform the analysis, the stench was so great that everybody had to retire from the laboratory to avoid it. The filtered refuse was as impure as ever.

If we travel northwards, into the manufacturing districts, we there see the streams which, in their aboriginal state, were limpid and pure, partake of all the colours of the rainbow, and tainted in every degree of impurity. These facts are not encouraging for the use of river-water for domestic purposes; and, taking a general view of the future—as well as the present state of things—it can hardly be expected that any amount of improvements can render the rivers generally fit for such purposes, however they may be improved as arterial drains. If it were necessary to adduce further proofs in support of this view, the application of sewage as manure to the surface of farm land would be sufficient in itself to satisfy any doubt, for although a large proportion of the manurial elements will be absorbed by the soil, there will still remain on the surface a proportion to be washed off by storms and otherwise, which will taint the rivers very objectionably, and will necessarily become greater as sewage irrigation extends.

That wells are too costly and too precarious a source, and rivers too foul and already too much reduced in volume to serve commonly as sources of water supply, is not an original view. The General Board of Health, in

1850, rejected the two sources of rivers and wells as a means of supplying the metropolis, and recommended the storage of drainage water instead. It is not necessary to endorse the views of the Board of Health in their application of this system to the metropolis, as the assumptions on which they were based have not stood the test of subsequent experience; but in a modified shape, the views of the Board appear applicable, especially to small towns and villages in rural districts. The collection of surface water in reservoirs before it reaches the rivers has been most successfully carried out in many of our larger towns in the north of England, viz., Greenock, Glasgow, Bolton, Liverpool, Manchester, Oldham, and many others. All have their gathering grounds and reservoirs, and although some of these towns have been on short supply this last summer, yet there is little doubt but that, such as the supply has been, it was better than could have been obtained from other sources.

These northern towns, however, have contented themselves with collecting the water from the surface only; in no instance, that I am aware of, has it been thought necessary to resort to under-drainage as a means of increasing and purifying the supply, as the gathering grounds have been in rocky districts of the primary formation, and the water collected has been sufficiently pure without it. But this superior condition of surface formation applies to a small proportion of England only. It is with the flatter districts, upon which small rural towns and villages are numerous, that we have at present to deal; and I will now endeavour to show how, by the storage of surface and drainage waters, they may be furnished with water in the driest summer.

There are few small towns and villages which have not in their origin had some reference to the existence of water in the shape of a spring or a stream. If it be a spring of sufficient volume it may be hardly possible to improve the supply, though as compared with the water of drainage it may be hard and inferior. If it be a stream of like sufficiency, untainted by sewage and manufactories, the same remark may apply; but if the stream has become impure by the extension of trade, by the use of water-closets, or by any other mode of defilement, the only question that will arise before rejecting it will be whether there are not times during the winter season, in which the impurity becomes so small by the dilution of rainfall, that, with the help of strainers and filters, a sufficiency of the improved supply may be collected and preserved for summer use. It is more than probable that an examination of the facts in many cases would show that this could be readily done. When the relative height of the brook and the town will not allow of a reservoir being filled directly by the former, recourse can be had to a wheel or ram to raise in winter the summer supply. The best formed hydraulic rams, made by Easton and Amos, or Freeman Rowe, with an available fall in the stream of 7 feet, will raise to the height of 30 feet one-eighth of the quantity that sets them in motion, and assuming a reservoir formed above the village to receive the water raised, a stream discharging 23 gallons per minute during the winter and spring, will be sufficient to raise in 180 days 720,000 gallons for use during the summer and autumn. A turbine, or an overshot wheel, might take the place of the ram with advantage when the quantity of water to be raised is greater than that stated. But of course the expense of either ram or wheel and attendant works would be saved in those instances where water can be brought from a height and conducted at once into the service reservoir, with an overflow to discharge the excess when the reservoir is filled. But in many instances, even where streams exist, a better supply may be obtained by the underdrainage of land in the neighbourhood; and if we resort to it, we have data which will quite satisfy the most fastidious inquirer, showing that the minimum discharge will afford a sufficient quantity of the very best water, if the area of drained land be sufficient. It is surprising, too, how few acres of land will suffice for the purpose.

When land is underdrained at sufficient depth (that is, 4 feet at least) the drains generally commence running in the month of October, and cease to run about the end of May. The proportion of the rainfall which the drains will discharge in that period will necessarily depend upon the nature of the drained land, for the larger the proportion of sand or gravel the more quickly will the rain be absorbed and discharged, and the larger will be the quantity available. In reverse degree will this be the case when the soil is clay—the denser it is the less will be discharged. The proportion discharged will vary (according to the qualities explained) from more than two-thirds to about one-fourth of the rainfall; thus, with a winter fall of 10 inches of rain and snow, when the latter is melted the maximum may be taken at 160,000 gallons per acre, and the minimum at 60,000 gallons per acre for every acre drained. The mean discharge of drained lands may be fairly taken at 100,000 gallons per acre.* The water of under drainage is free from all animal and vegetable matter, for the four feet of soil through which it passes absorbs all ammonical matter, and, in fact, forms the best chemical filterer that is known.

Analyses made of drainage waters with a view to ascertain their value for domestic purposes have exhibited most conclusive proofs of their superiority over other supplies, when to purity is added the quality of softness, which, for household uses, is a great desideratum. In this particular all evidence supports the conclusions come to by the Board of Health in 1850, but the quantity that the Commissioners assumed would be available is not supported by experience, and therefore it is that, except in a very few cases, the water of drainage may not be found applicable to large towns, though specially suitable for small ones.

If we apply the system of storing drainage water for the supply of villages in summer, we may test the question in its monetary aspect by assuming the average population of rural villages to be 400. If each inhabitant requires 10 gallons of water per diem (a quantity quite sufficient in places where the water-closet system does not wholly prevail) it will require a supply of 480,000 gallons for the summer. This quantity is taken on the assumption that for 120 days, or four months in the year, there will not be a supply from ordinary sources. To secure this net quantity, a considerable allowance must be made for waste by evaporation, and 50 per cent. on the quantity required should be added to meet this loss. A reservoir, or basin, to hold 720,000 gallons will, therefore, be required, and this quantity of water must be stored.

It requires very little calculation to show that if an acre of land, during the period of discharge, will yield 100,000 gallons, it requires less than 7¼ acres to yield the required quantity for 400 persons, or 12 acres of land where the soil is of the densest character. These numbers of acres would have to be increased where the rainfall is so far below the average that a minimum quantity of ten inches cannot be depended upon during the discharging period. The reservoirs necessary to hold 720,000 gallons would be rather more than $\frac{4}{10}$ths of an acre, if the depth were taken at 7½ feet. This extent is too large for covering at a cost moderate enough for village economy, and therefore the probability is that open ponds will take the place of reservoirs, if they could be made in some convenient place above the village, and could be shaded from the sun and protected from the wind. The expense of making the pond, using the earth to embank it, and planting the embankment so as to exclude as much as possible sun and wind, and thereby to reduce evaporation and preserve the purity of the water, would be as follows:—

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* See Paper on "Rainfall," *Society of Arts Journal*, January 5th, 1859.

Excavation and embankment, assuming that the earth thrown out formed a bank round the pond on which trees and shrubs may be planted, 2,500 yards at 6d.	£62	10	0
Puddling bottom and slopes, dressing bank and gravelling bottom 6 inches deep on the puddling, and constructing overflow from reservoir	102	10	0
Planting and fencing	30	0	0
Value of land appropriated to the purpose, three-quarters of an acre	45	0	0
Total cost of reservoir	240	0	0
Iron pipes from reservoir, with stop-cock, well, and brickwork	155	0	0
Four stand-pipes and taps	20	0	0
Total outlay	£415	0	0

Assuming these figures to fairly represent the cost of supplying a village of 400 inhabitants with water, and the number of houses or cottages in the village to be 100, it follows that the cost per person would be £1 0s. 9d., and the cost per house £4 3s. If the cost were charged upon the houses, and the money were borrowed to do the work, it could be repaid by instalments with interest in thirty years at 6¼ per cent., and the annual charge would amount to £26, or a charge upon each house of not quite 5s. 3d. per annum.*

The capability of thus supplying villages with water is not conjectural;—every day's experience in drainage only confirms the conclusion that there are few villages in which something of the sort might not be devised. In fact the figures given represent the worst aspect of the suggestion, for nature frequently affords opportunities of collecting the water of drainage without recourse to artificial ponds, in hollows and ready-made receptacles which may be appropriated with advantage.

Of course it is assumed that there are lands above the village which require drainage and would supply the required water, and that the reservoir shall be so much above the village, that by means of iron pipes, with stand-pipes and taps, the water could be delivered down the street at convenient places, for the use of the poor.

At present legal powers do not exist enabling cottage owners in villages to charge their properties with the cost of water-supply. But this question is one of detail only, which will be met when the object is recognised as one worthy of legislation.

In closing this paper, which I am well aware is very deficient in detail, I trust I may be allowed to express the hope that I have stated enough to attract public attention generally to the important matter of the water economy of our country, and to that of the rural districts and villages in particular.

I regard drainage in its various branches in conjunction with those natural sources which are beyond the reach of defilement, as the most simple and certain means of furnishing a pure supply. This view is based on the broad facts, 1st, that of the 20,000,000 of inhabitants in England and Wales, about one-third, or perhaps 7,000,000 may be considered to be scattered over the face of the country in small towns and villages; 2nd, that whereas there are at least 16,000,000 acres of wet land in England which require draining, if they are not already drained, it would only require the water of drainage from less than 250,000 acres to supply the whole of that population with water in summer; and 3rd, that this water, which is the best of all water, is *created* by drainage, inasmuch as it would be evaporated from the surface if drainage did not discharge it.

But let this be as it may, the whole subject of our water economy is one of great national importance, and it is becoming more so every day. At present it has only been measured by partial works and interested parties. Individual towns have sought the water they require by special Acts of Parliament; the owners of streams have joined together to protect their fishing rights; towns still discharge their sewage into rivers and streams which supply other towns with water; villages are robbed of streams upon which they had depended; farmers have lost the supplies which satisfied their stock in summer; the water of under-drainage is allowed to run to waste; the waters of districts are thrown down into lower valleys, to commit injury there; and all these individual proceedings are allowed to go on because the task of reformation is too large for private legislators to take in hand, and the Government are not yet impressed with the magnitude and importance of the subject.

DISCUSSION.

Mr. J. F. Bateman, F.R.S., said he was sure they were all indebted to Mr. Bailey Denton for bringing this subject before the Society, and he so entirely agreed with the general principles of the plan put forward, that he was little disposed to quarrel with the details. There could be no question that a large quantity of water which might be made available was often allowed to run to waste, and no doubt the view expressing the practicability of utilising the water from under-drainage was quite correct in a great many cases, particularly in small villages; but he (Mr. Bateman) did not think it would be applicable to large towns, where, generally speaking, such a supply would not be at a sufficient elevation. While, however, he agreed with Mr. Denton in the main features of his scheme, there were some points of detail on which he might be permitted, having had some experience on this question, to comment. In the first place, the estimate of drought—120 days in the year—was in his opinion too low for the eastern portions of the country, particularly for those flat districts where this mode of supplying water would be most applicable. At Newcastle-on-Tyne, which was on the eastern side, there had been on several occasions droughts of 240 days; and from November to May, in one year, the whole amount of rainfall supplied to the reservoir was only 2½ inches. Any scheme of this kind, therefore, based upon the calculation of drought and of percolation which Mr. Denton had brought before them would fail to secure the object in view; if, however, the reservoirs were sufficiently large, and the drainage ground sufficiently extensive, those difficulties could be overcome. Mr. Denton had proposed a reservoir of a given area with a depth of seven feet. He thought this was an error in the scheme, and that the depth of the reservoir ought in no case to be less than fifteen feet. Moreover, he did not think it well that it should be shaded by planting trees round it, for the introduction of a large amount of vegetation was highly objectionable. Again, if the reservoir were small and shaded in the manner proposed, the effects upon so small a stagnant mass of water would be highly prejudicial. This did not apply with equal force to large lakes, occupying an extensive area; but small ponds, which could not be agitated by the wind, always became foul after a time. He mentioned these matters because he hoped the suggestion which Mr. Denton had brought before the meeting would be practically acted upon, and he should be sorry if any errors of detail should mar the success of his plan. He hoped to see the rivers and streams of the country used to greater advantage than they had been for the wants of the population, and that they should be unpolluted by sewage. He quite agreed with Mr. Denton in the views he had expressed of the practicability of rendering useful by storage the water now being drained from valleys, and as yet only productive of floods in winter. He only hoped the subject would be taken up in a practical way by those for whose benefit Mr. Denton had introduced it, and that small towns would thus be better supplied with water, be more independent of weather and seasons, and the rivers more free from pollution.

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* Considerable objection is taken to planting round reservoirs, because leaves fall into the water and cause impurity. But, when the reservoir is annually emptied and cleansed at the end of the season of supply, this objection does not apply.

Mr. **Dugald Campbell** said he thought, on the chemical question, Mr. Denton was correct in saying that at present a great number of rivers were in such a state that it was impossible to resort to them for water supply to the population. He hoped the time would come when they would be so purified that they might be reconverted into sources of supply for the domestic requirements of the inhabitants. As regarded the water which flowed from the land in the way Mr. Denton had described it, he thought in some instances it might do for domestic use; but from his own experience he believed in many cases it would not, as this would depend upon the materials of which the soil through which the water passed, was composed. He granted that, to a great extent, the ammonia and other material substances would be removed from the water, but in calcareous soils it would be impregnated with lime, and be inappropriate in many respects for domestic purposes. He felt much indebted to Mr. Denton for the way in which he had brought forward this subject, and he hoped that a fair trial would be given to his scheme, which he had no doubt would in many instances prove a success.

Mr. **Robert Rawlinson** said he had listened with some degree of pleasure to Mr. Denton's paper, and also with some degree of disappointment, especially in reference to the views expressed on various points of meteorology, with which he (Mr. Rawlinson) did not agree. The supply of water to villages was a question of great importance; the purification of our rivers was of no less importance; the application of sewage was also equally important; but he thought in treating these subjects Mr. Denton ought to have taken more notice of those who had gone before him on these questions. A great many experiments had been made with regard to the utilization of sewage, and the filtration of sewage water, by men whose names were eminent in science, and the meeting might have been informed of the results of those experiments. Then again, the Government had not quite so entirely neglected the question of the pollution of rivers as was implied in the paper. A Government Commission had been appointed to consider the injury done to rivers by sewage, by manufactures, and by dye works, and other causes; what might come of it remained to be seen. With regard to the rainfall, a knowledge of its volume alone was of very little use, for a district that gave relatively to another a much smaller volume of rainfall might still give as large an available supply for practical purposes, this depending to a great extent upon the intervals at which the rain fell. There were in the paper certain conclusions which he did not think were quite logical. They had the statement that water which had been corrupted by the refuse of dog kennels, had been by the process of filtration rendered clear, though not sweet. On the other hand they were asked to believe that water flowing over manured lands and then drained off was fit for domestic use. He did not say that deep drainage water would not in many cases be so, but he thought they should know something more of the conditions under which it was filtered. Then again he found fault with Mr. Denton for not telling them something of the actual results of land filtration upon a large scale which had been published from experiments carried out at Rugby. Then there was Croydon, where the experiment was carried out on the grandest scale, and where the water sewage of the town had been passed over and through the land for several years, and where they were under an injunction of the Chancellor that the water should not go into the river in a state more impure than the river itself was at ordinary times. He knew that experiments had resulted satisfactorily, so far as this, that the effluent water did flow off in a state not more impure than the river into which it was discharged, and so little objectionable was it that adjacent landowners had taken it into their grounds for ornamental purposes. He did not say he advocated such a supply for domestic use. As far as his own knowledge went there was no known process by which sewage water could be chemically treated so as to render it pure. All the so-called disinfectants had indeed hitherto failed in purifying the water from the salts, or, at all events, had failed to render the residuum sufficiently valuable as manure to pay for the process. But he believed it was recorded in the report of the Sanitary Commissioners (the analysis of the water having been made by Mr. Way, and the experiments conducted by Mr. Lawes and Dr. Gilbert), that the discharging of sewage water on to land did take out of it all the salts of the sewage, but that the water came off impregnated with the mineral properties of the land through which it was filtered. It seemed that it left the sewage salts in the land, and took up something from the land that it more readily assimilated with. It was a law of chemistry that to discharge one salt you must give the water something else in the place of it, and to make it as pure as rain water he was not aware of any process except evaporation. The question of a supply of pure water to villages was one of the utmost importance, for during last summer many villages throughout the country were obliged to resort to all the foul sources in the neighbourhood for water, and had to go long distances sometimes to supply themselves even from stagnant pits. One of Mr. Denton's reservoirs, though it would not give them water in all respects unobjectionable, would give them a more abundant and a better supply than that which they had been compelled to resort to. He thought the estimate given by Mr. Denton, as to the cost of the reservoirs, was much too low. A reservoir to contain that quantity of water should have more labour bestowed upon it, and he hoped if Mr. Denton was called upon to carry his plan into operation he would have the courage fairly to face the cost. He joined in the objection stated by Mr. Bateman to the shading of the reservoirs by planting trees and shrubs round them. They should also be much deeper than Mr. Denton had proposed, so as to prevent impurities from decayed vegetation and the growth of animalculæ. He contended that villages could very well afford to pay for a proper water supply, and he sincerely hoped the great landowners of this country, who had taken up the question of house accommodation on a great scale, would take up this further question. He hoped instead of relying upon subsoil drainage water, they would go further afield, because he was sure Mr. Denton would agree that where there was subsoil drainage water, there was not far off spring water. He (Mr. Rawlinson) would prefer to collect the springs, bring them down by contour lines, and place them—not in the open air, to breed tadpoles and animalculæ—but in reservoirs, with vertical sides, deeper than had been indicated, and if not covered over with brickwork, at least raftered over and covered with shingles, so as to keep out the sun and prevent vegetation. He was obliged to Mr. Denton for bringing the subject forward, and he hoped he would perfect his plan as far as possible, not confining the cost to £415 for works to contain nearly a million gallons of water. From his own experience he judged that the cost of a proper reservoir for this purpose ought not to be less than between £4,000 and £5,000.

Mr. **Baldwin Latham** remarked that Mr. Denton appeared to repudiate wells on the authority of the General Board of Health. Their objections, however, extended not to deep wells, but to shallow ones. Such wells certainly were not desirable in any respect, but when Mr. Denton quoted the case of the deep wells of London he thought he was in error. London seemed unfortunately cut off by some convulsion of nature from the supply of water which was otherwise due to it, and it would seem that it was in the ground of the Kent Waterworks, which could pump seven millions of gallons per day, that the fault which intercepted the water of London existed. On one side of the ground they got no water, and on the other side it was abundant. In the works at Croydon they raised 2½ million gallons per day from wells sunk in the chalk, so that instead of ignoring wells altogether, he regarded them as the best and cheapest mode of collecting a supply of water. It was no doubt advisable in many places to carry out the plan suggested this evening, inasmuch as wells were not always available, this being dependent upon the geological formation of the locality. With regard to the pollution of rivers, Mr. Denton seemed to fear that there was no legal power to prevent sewage being turned into them, but the Croydon case showed the contrary. Previous to the injunction from the Court of Chancery they had been spending £3,000 a year for that which turned out unsuccessful; but since they had gone to nature, instead of spending, they made a clear profit of £300, which he thought was a fact worthy of notice, and he would add that the water which was discharged from the irrigated lands was of purer quality than that which was now supplied to the city of London. Analysis had shown that the water from this irrigation contained only twenty-three grains of organic and inorganic matters per gallon, while that which was supplied for the public use at Croydon contained twenty-two grains of those matters. There was another question of importance which had been solved at Croydon. It was a generally-received opinion that sandy soils only were available for sewage irrigation, but for the last eighteen months sewage had been applied on brick-earth, which was not worth £1 per acre, and he was happy to say, during the last year, that land produced sixty tons per acre of Italian rye grass, and the water which passed off was as pure as in the other case.—In reply to questions by Mr. Rawlinson and Mr. Bachhoffner, Mr. Latham stated that the amount of organic and inorganic matters in the Croydon water was thirty-nine grains per gallon in the water passing upon the land, and twenty-three grains in that which was discharged from it.

Mr. W. **Botly** thought from the statement of cost they had heard from Mr. Denton, that the reservoir system, as applied to villages, was the most economical means by which a water supply could be obtained; but he also thought that wells, when sufficiently deep and in favourable situations, should not be neglected.

Mr. **Benjamin Shaw** said that in villages at the present moment the question was not so much one of the best supply as of the getting any supply at all. Many villages were in such a condition with regard to water supply as highly to favour the advent of cholera. When they looked at the existing legal powers to meet this difficulty, they were very small indeed. By the Public Health Act of 1848, it was provided that in places where the provisions of that act were not brought into operation, it was in the power of the churchwardens of the parish to call a public meeting; and, by the sanction of a majority of three-fifths of those present, power was given to sink a well, and to charge its cost upon the rates. It was evident, from what they had heard this evening, that the power to dig one well was a very insufficient remedy for the present state of things; but if the inhabitants chose to bring themselves under the operation of the act, they had power to create for themselves a water supply. But, unfortunately, this was a matter which was left to the inhabitants themselves, who, it was to be feared, were in many cases ignorant of or insensible to the evils from which they suffered. Looking at this state of things, it occurred to him whether this Society could not enter into communication with the government with a view, in the first place, of getting an inquiry into the water supply of villages and small towns. He believed they would educe very valuable results, and, following upon that, he hoped legislative measures would be enacted, not only enabling, but compelling such places as required it, to provide for themselves a proper supply of water.

Mr. R. B. **Grantham**, F.G.S., having expressed his personal acknowledgments to Mr. Denton for his paper, said in his position as an inspector under the Land Drainage Acts referred to in the paper he had had some experience both in land draining and arterial works; and his principle had always been to induce parties undertaking large district drainage to store the water in reservoirs in every possible way, for use in time of need. There were many cases in which he knew the land would be materially benefited and the water supply enhanced by those means being adopted. He could not agree with Mr. Rawlinson that the paper was defective from not entering more fully into the question of the fouling of rivers. He did not think Mr. Denton had that point in view in writing this paper. His principal object was to show how to supply water to villages, and for that purpose he had laid down a proposition with which he (Mr. Grantham) agreed, that was, storing the water, taking the springs from the head as much as possible, and preserving it in a reservoir. As to the water from under drainage not being pure, he thought contradiction was given to that assertion in the case of Croydon. That drainage water passed through a depth of four feet of soil; and practical testimony had been afforded this evening that it was within one grain per gallon as pure as the water that was supplied for the use of the population. He added that Mr. Denton had laid before the Enclosure Commissioners a scheme which he (Mr. Grantham) had examined, in which he proposed to carry out his principle of storing water from a very low marsh district, to the north of Frodsham, comprising 4,200 acres, which would afford a grand opportunity of testing the practicability of the plan now before them; and he sincerely hoped that that opportunity would be afforded to Mr. Denton.

Mr. **Howard** (of Bedford) said, as an inhabitant of a rural district, he felt very much the importance of the subject. He was aware of the impure quality of water that was used, because there was no adequate supply in a great many places. In his own district he had dug a pond one-third of an acre in extent, at an expense of £50, in which he stored the water which fell in the winter for use in the summer, and the inhabitants, he believed, were very much obliged to him for having done so. He thought the meeting ought to be made acquainted with the fact, that Mr. Denton had laid before the Privy Council the whole question of the water economy of this country, and he (Mr. Howard) thought the government ought to have taken it up.

Dr. **Bachhoffner** remarked that the subject of water supply was of especial importance, anticipating, as we did, the visitation of cholera next year. He believed it was the universal opinion of medical men and chemists that surface water was about the worst that could be employed for domestic purposes, and he could not imagine that filtering it through a few feet of soil could really render it wholesome. Whilst Mr. Denton averred that no process whatever could render the sewage water available for domestic purposes, he asked them to use the water that had passed over ploughed and manured lands, and finally through a few feet depth of earth.

Mr. **Cooper** said, with regard to the question of precipitating sewage water so as to make it fit for domestic purposes, his own experience led him to the conclusion that it was impossible in the present state of chemical science. With regard to the shallow storage which was suggested for the use of villages, he felt bound to say he could not give his approval to such a reservoir as that proposed by Mr. Denton. There was one point on which he should like to have had more definite information—that was as to the amount of water which an acre of ground, by ordinary drainage, would yield for the supply of these reservoirs. He did not agree with Mr. Denton on this point.

Mr. RAWLINSON begged permission to add, that to judge by Mr. Denton's paper, he really seemed to be unaware of the action the Government had taken. In the year 1858 the Government appointed a Royal Commission to inquire into the application of sewage, and their report had been published, with all the details. At the end of the last session of Parliament the Government appointed a Royal Commission to inquire into the pollution of rivers, in which, he maintained, that water supply was included.* He thought these facts ought not to have been ignored.

The CHAIRMAN said, in making a few remarks on the subject before them, he could not do better than, in the words of Mr. Bateman, express a hope that the parties for whose benefit Mr. Denton had brought this matter forward would avail themselves of the information which had been conveyed upon it. He thought some of the speakers this evening had overlooked one fact which Mr. Denton brought forward with sufficient prominence, viz., that in every district the local circumstances of that district must be considered; but irrespective of those local circumstances there were general principles which should be regarded where no local circumstances existed to counteract them. They were indebted to Mr. Denton for insisting upon the importance of storing the rain water during the time at which it fell, to make use of at times when it did not fall. He had also done good service in showing them that in this country we need not be under the alarm of a deficiency of water; for though the total amount of water which fell in the year might be decreased by the improved processes of agriculture, yet that from our maritime situation sufficient rain would be sure to fall if we took care to economise it properly. Some observations had also been made with regard to the insufficiency in the amount of storage which Mr. Denton had recommended. He thought, however, that a low standard was better than no standard at all; and, as had been remarked by Mr. Shaw, in many of the villages there was scarcely any water supply. Under those circumstances this secondary supply, though not so ample as could be wished, must be regarded as of great importance. Another point of view was this, that after all, our supply of water came from the ocean in the form of rain, and the more directly we could utilize it the better. If we used the rain water before it had time to be drained into the river, we obtained it in a purer state. The observations upon sewage, made by some of the speakers, though not strictly bearing on the question, were nevertheless of such intrinsic interest that he felt he ought not to check them, proceeding as they did from gentlemen of large practical experience, some of whom were of opinion that sewage irrigation water might be thrown into the river without injury. However that might be, he trusted that would only be acted upon as a *dernier ressort*. He concluded by proposing a cordial vote of thanks to Mr. Denton for his remarkably interesting and valuable paper.

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* The following is a copy of the commission referred to:—

"RIVERS POLLUTION.

"VICTORIA R.

"Victoria, by the Grace of God of the United Kingdom of Great Britain and Ireland, Queen, Defender of the Faith,—To Our trusty and well-beloved Robert Rawlinson, Esquire, John Thornhill Harrison, Esquire, and John Thomas Way, Esquire, Greeting! Whereas We have deemed it expedient for divers good causes and considerations that a Commission should forthwith issue for the purpose of inquiring how far the present use of rivers or running waters in England for the purpose of carrying off the sewage of towns and populous places, and the refuse arising from industrial processes and manufactures, can be prevented without risk to the public health, or serious injury to such processes and manufactures, and how far such sewage and refuse can be utilised or got rid of otherwise than by discharge into rivers or running waters, or rendered harmless before reaching them; and also for the purpose of inquiring into the effect on the drainage of lands and inhabited places, of obstructions to the natural flow of rivers or streams caused by mills, weirs, locks, and other navigation works, and into the best means of remedying any evils thence arising:

"Now know ye, that We, reposing great confidence in your zeal and ability, have authorised and appointed, and do by these presents authorise and appoint, you the said Robert Rawlinson, John Thornhill Harrison, and John Thomas Way, to be Our Commissioners for the purposes aforesaid.

"And for the better enabling you to form a sound judgment on the premises, We do hereby authorise and empower you, or any two or more of you, to call before you, or any two or more of you, all such persons as you may judge most competent by reason of their situation, knowledge, or experience, to afford you correct information on the subject of this inquiry.

"And it is Our further Will and Pleasure that you, or any two or more of you, do Report to Us in writing, under your hands and seals, your several proceedings by virtue of this Our Commission, together with your opinion on the several matters herein submitted for your consideration.

"And We Will and Command that this Our Commission shall continue in full force and virtue, and that you, Our Commissioners, or any two or more of you, may from time to time proceed in the execution thereof, although the same be not continued from time to time by adjournment.

"And for your assistance in the due execution of this Our Commission, We have made choice of Our trusty and well-beloved Godfrey Lushington, Esquire, barrister-at law, to be Secretary to this Our Commission, whose services and assistance We require you to avail yourselves of from time to time, as occasion may require.

"Given at Our Court at Saint James's, the Eighteenth day of May, 1865, in the Twenty-eighth Year of Our Reign.

"By Her Majesty's Command.

"(Signed) G. GREY."

INSTRUCTIONS TO THE COMMISSIONERS.

"Whitehall, 30 May, 1865.

"GENTLEMEN,—Her Majesty having been pleased to appoint you to be the Commissioners for Inquiry into the Pollution of Rivers, I am directed by Secretary Sir George Grey to send you the following instructions for your guidance in the proposed inquiry.

"Although it may be taken as proved generally that there is a widespread and serious pollution of rivers both from town sewage, and the refuse of mines and manufactories, and that town sewage may be turned to profitable account as a manure, there is not sufficient evidence to show that any measure absolutely prohibiting the discharge of such refuse into rivers, or absolutely compelling town authorities to carry it on the lands, might not be remedying one evil at the cost of an evil still more serious, in the shape of injury to health, and damage to manufactures. It is, therefore, suggested that your inquiry should include selected river basins, illustrating different classes of employment and population; that these river basins might be:—

"1st. The Thames Valley—both as an example of an agricultural river basin, with many navigation works, such as locks, and weirs, and mills affecting the flow of water, and many towns and some manufactories discharging their sewage and refuse into the stream from which is mainly derived the water supply of the metropolis.

"2nd. The Mersey Valley—including its feeders, particularly the Irwell, as an example of the river basin, most extensively polluted by all forms of manufacturing refuse, particularly that arising from the cotton manufacture, and processes connected therewith.

"3rd. The Aire and Calder Basin, as an additional example of the same class, particularly in connection with the woollen and iron manufactories.

"4th. The Severn Basin, for the same reason, but in particular connection with the great seats of the iron trade.

"5th, The Taff Valley, in connection with mining and industry applied to metals.

"6th. A river Basin comprising a mining district in Cornwall.

"Your special points of inquiry should, it is conceived, be in the Thames Valley. 1. The condition of the river as affected by mills, weirs, and locks, and as affecting the drainage of towns and villages and adjacent lands. 2. The condition of the river, as affected both by the discharge of sewage from towns and villages, and the refuse of manufactories, paper mills, &c., and the possibility of intercepting and rendering useful or innocuous these sources of pollution.

"As to the other rivers mentioned, the main object of the inquiry should be how far the use or abuse of the rivers is, under present circumstances, essential to the carrying on the industry of these districts? How far by new arrangements the refuse arising from industrial processes in these districts can be kept out of the streams, or rendered harmless before it reaches them, or utilised or got rid of otherwise than by discharge into running waters? In the course of these investigations you will make inquiry into the effect on health and comfort of the existing system of sewage of towns and populous places in the districts examined, and into the best mode of protecting individual and public interests in the purity of running water.

"Secondary questions will, no doubt, arise contingent on these leading points, in which case you will include them, as far as it is necessary, within the scope of your inquiry.

"I am, &c.,
"(Signed) H. WADDINGTON.

"R. RAWLINSON, Esq.
"J. T. HARRISON, Esq.
"J. T. WAY, Esq.
} Commissioners to inquire into the Pollution of Rivers."

Mr. Bailey Denton, in reply, said, as the Chairman had very kindly, and in much better language than he could employ, exposed the irrelevancy of much of the matter that had been introduced into the discussion, he would do no more than simply reiterate that the paper was not designed as an essay upon the utilisation of sewage or the purification of rivers, but as a proposal for the better supply of water to villages and towns in rural districts, which several of the speakers had shown to be in a very lamentable condition. Considering, as he did, that the time was past for the purification of rivers to an extent such as would make them palatable to human beings, he would abstain from discussing that question. In his paper he had stated emphatically, what he believed would be found to be the case, that we must not look to rivers in future as sources of supply, except at the uppermost ends and tributary streams, which had not been contaminated by the refuse of towns. Mr. Rawlinson had done him the honour of making many observations, which savoured rather of disapproval, but the context of his remarks was so concurrent with his (Mr. Denton's) own that he was willing to let the objections pass (as they were objections in detail, and not upon the principle) rather than trouble the meeting with a reply. There were some observations made by Mr. Rawlinson, with respect to what the Government were doing, which he confessed had taken him by surprise. Mr. Rawlinson had stated that the Government had issued a commission for inquiring into the subject now under discussion. He (Mr. Denton) was aware that a commission, of which Mr. Rawlinson was a member (and no one could be more fitted for the office), existed for inquiring into the pollution of rivers, and the means of purification. He did not understand that that commission was to inquire into the larger question of water supply; and, moreover, having read the terms upon which the commission was constituted, he saw that the subject of water supply was mentioned only incidentally, and was certainly not included in the duties of the commission. One of the speakers had said that he could not see the difference between filtrated sewage water and the water of under drainage, inasmuch as the latter passed through soil in which farmers' manure was placed, but it must be remembered that the proportion of manure usually placed on the surface of the ground was so small, as not to bear any comparison with the manurial elements of sewage. He himself, as a farmer, knew how little manure he was compelled to be satisfied with, and considering, too, that there were four feet of soil between the surface and the drains, he thought the comparison just referred to would not hold good, for in the case of drainage there was very little contamination and a great amount of filtration. With respect to Mr. Bateman's objections to the small depth of reservoirs he had proposed, 7½ ft., he had only to remark that he was fully aware that a greater depth would be preferable, but the real difficulty in the matter was limiting the outlay to such a cost as would induce those interested in rural districts to incur it. Every foot of additional depth, particularly in the less hilly districts, was a great additional cost, and this would materially tend to defeat the object in view. Knowing, as he (Mr. Denton) did, the feelings of landowners, he was sure the mere mention of such figures as Mr. Rawlinson had given (£5,000 for a reservoir) would at once put an end to any proposal of the kind. Remembering also, as he did, that the majority of the ponds, out of which the rural population and stock were now supplied, were not half the depth that he had suggested, and that the coolest and best water was that in ponds under the shadow of trees, he could not help thinking that the plan he had put forward, if not the best possible, was at all events the most practical. Mr. Baldwin Latham had taken objection to his rejecting deep wells as a means of supply to villages, but he repeated that if the deep wells were to be as costly as they usually were, and to involve a constant expenditure to raise the water, they were not the proper things for villages, but wells of a moderate depth were precisely the things that were required; and, to show that he was sensible of the advantage to be derived from wells, he might mention that he had, at his own cost, sunk one in his own village, Stevenage, which supplied the whole of the poor during last summer, and that he did this at a total cost of £20, including the pump.

Proceedings of Institutions.

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Royal Polytechnic Institution Classes. — The ceremony of distributing the prizes and certificates, to the members of the evening classes of this Institution, took place on Tuesday evening, the 21st of November, in the presence of several of the directors and a very numerous audience. The total number of certificates given was 40, of which 21 were given by the Society of Arts, 11 by the City of London College, and 8 by the Department of Science and Art. These certificates were obtained by twenty-five persons, of whom seven were ladies. The prizes were presented by Mr. T. Chambers, M.P., Common-Serjeant, and the various successful candidates having been called up and received their rewards, the Chairman addressed the audience at some length, speaking in high terms of the utility of the Institution, and specially praising evening classes as a means of education for a large and praiseworthy class of young persons. He congratulated the holders of certificates, who had shown in the most conclusive manner that they must not only have resisted many temptations to idleness, which temptations were to be found in greater abundance in London than in any other city in the kingdom, but they had resisted those temptations to amuse themselves in order to devote themselves to study in the evening in a place which, at all events, was devoted to some extent to amusement as well as instruction. Addresses were also delivered by the Rev. C. Mackenzie (the hon. manager of the evening classes), the Rev. J. B. Owen, and other gentlemen. Mr. A. Ross, in seconding a vote of thanks to the chairman, which was moved by Mr. Owen, stated that 415 students had entered themselves for the evening classes of this Institution for the present quarter. The entire sum presented amounted to £36 15s.

Worcestershire Union of Educational Institutes. —The annual meeting of the Worcestershire Union of Educational Institutes was held at Kidderminster on the 15th November. The proceedings commenced with a morning meeting of delegates, followed later in the day by a public dinner, at which the Right Hon. Sir J. S. Pakington, Bart., M.P., presided, and subsequently by an evening meeting. At the morning meeting the chair was taken by Mr. J. S. Pakington, and among those present were Sir J. S. Pakington, M.P., Sir T. E. Winnington, M.P., Mr. Grant, M.P., &c. The President, in opening the proceedings, observed, in the course of some brief remarks, that the state of the finances of the Union was the most satisfactory that they had ever known. He then read the report, which stated, "that, despite the somewhat adverse aspect of adult education, the committee are in no way discouraged. The distinctive work which the Union was formed to promote, is steadily progressing, as seen by the large increase of candidates for the various prizes; the educational appliances also are in a much more satisfactory condition now than at the time the Union was first formed. The committee feel that the objects aimed at by the Union will be found amongst the most effectual aids to the well-being of individual Institutes. They would therefore impress upon all the friends of education the need of making increased efforts not only to enable the Union to continue its present course of usefulness, but, by enlarged contributions, further to extend it. Organisations similar to our own are on the increase. Amongst the most recent and promising of them is the Kent Association of Institutes. The Staffordshire Union also is making increased efforts in the cause of education. Your committee, however, feel assured that now the Worcestershire Union has taken its place as a thoroughly established society in the county, its friends will rally round it, and thus enable it to carry out its great aim—that of the social, moral, and intellectual improvement of the masses." Thus, while the report showed a decrease of two in the Institutes and one in the night schools respectively, the returns of the number of members in the Institutes showed a larger proportion than last year, and the female members were greatly on the increase. The number of Institutes in the Union was 26, and of members in 22 of these Institutes, 3,788; the female members being 301. The aggregate income of 21 of the 26 Institutes was £1,784 13s. 2d. The report was adopted, and Mr. J. S. Pakington was re-elected president. The vice-presidents, with the addition of the name of the Rev. T. L. Claughton, were re-elected. The other officers were also appointed. Sir J. Pakington proposed that the next annual meeting of the Union be held at Cheltenham, which was adopted.

PARIS EXHIBITION OF 1867.

The Imperial commission has lately been much occupied with the consideration of the means of securing the best possible illustrations of those industries which depend entirely, or principally, on manual labour, skill and taste. Every effort is being made to give to that department, which in 1862 was called the Process Court, great extension and importance, not only as respects French exhibitors, but those of all parts of the world. Artizans may be divided under three heads—First, those who work with and direct machinery; second, those who perform work which is also done mechanically; and, third, those who by their dexterity, intelligence, taste, or other qualities, have to the present time, resisted most effectually the concurrence of machinery. The commission says, and truly, that the first of these classes is almost the only one which has been represented in former exhibitions, and its object is to bring forward the other two, in order to inculcate useful lessons to all, and to bring to light all the various abilities of the artizan. In order to do this, the commission desires to see working in the exhibition men of all countries and callings, a working collection of the manual industries of the world, in order that working men may have a full share of the honour due to them, and that the public may benefit in an educational point of view. Such an exhibition is calculated also, says the commission, to throw light upon some of the most important questions of the present day, namely, the changes which are being made in the organization of labour in great factories, the struggle which is going on between great and small industries, and the destruction or preservation of family, or home labour. This last question is one to which the commission attaches great importance, and two classes are especially devoted to the tools, implements, processes and products of artizans working in their own homes. There is reason to hope, says the commission, that the contact of the most able and intelligent working men of all countries will aid in establishing harmony between the various nations, that all will find that they cannot claim absolute superiority over others, and that many opinions which have had deep root for centuries are nothing more than prejudices.

There is no doubt that the object in view is one of the most important and most interesting that can be included in an International Exhibition, but there is no concealing the fact that it is surrounded with immense difficulties as regards the execution. The Commission is also fully aware of this, but does not appear to shrink from the labour, outlay, and responsibilities which it must entail upon it. The means of carrying the idea into practice have been drafted out, and the following are the most salient points in the plan, which, however, must at present be regarded as merely suggestive. The Imperial Commission will take upon itself the charge of the French artizans, and will leave to the foreign Commissions the superintendence of their own countrymen, while special arrangements are made for the reception and superintendence of such other artisans as do not fall under either of these heads, who belong to countries only partially civilised, and not officially represented in the Exhibition. First, as regards French workmen, it is proposed that they shall be admitted, in some cases, on their own application, and in others, under the superintendence of a master, foreman, or delegate appointed by themselves. The Commission leaves to employers, local societies, and others, the charge of indemnifying the workmen under their care, and providing the means for their journey to and from the exhibition, and for their maintenance during their stay in Paris, but it will afford facilities for the sale of the products of these industries, and thus partially, if not entirely, provide for the expenses incurred. The goods produced within the exhibition, and, within certain limits, others from the same source, will be allowed to be sold either on the spot where they are produced, or in the bazaars which each country will be permitted to erect within the portion of the park allotted to it. In cases, however, in which the products are not saleable, the Imperial Commission is prepared to co-operate with the foreign Commissions or other representatives, and to contribute towards the support of the work provided, if it considers the object of sufficient importance to warrant the sacrifice. Another inducement held out by the Commission is that, in addition to medals awarded by the jury for superiority of workmanship, certain recompenses will be bestowed upon those workmen who exhibit the most remarkable aptitudes.

As regards the industries to be admitted to the exhibition, the only exceptions made are those of which the material or the processes employed are disagreeable, unwholesome, or dangerous, and those which require too much time for their development to allow them to be fully illustrated in a conveniently short space of time. It is understood, however, that a certain amount of originality, superiority, or special ingenuity will be demanded as the necessary qualification for admission; or, in other words, that the industry to be illustrated shall have a claim upon general attention.

In the classification of the workmen and industries, the Commission adopts the expressions *European* and *non-European*, the former including not only those actually placed in Europe, but those whose civilisation raises them to the European standard, while the other title designates the opposite. In the list of European industries which it is desired to see represented in the exhibition, we have, first, the class which works with the aid of machinery; we find, besides the great branches of manufacture, sewing and embroidery by machinery, the manufacture of boots and shoes, envelopes, medals, confectionery, ice, chocolate, metallic pens, thimbles, nails, pipes, fish-hooks, capsules, needles, pins, pencils, bricks, tiles, &c. In the second class, that of products in the manufacture of which manual labour competes with machinery, such as the making of thread, string, rope, tissues, needle-work, netting, and knitting, printing of all kinds, the making of shawls, carpets, tapestry, embroidery, and lace, corks, wooden shoes and clogs, rustic furniture, trellis-work, the woodwork of lucifer matches, hand-made paper, bookbinding, basket-work, button-making, brush-making, the casting of shot, &c.

The third class, that in which the excellence, dexterity, intelligence, and taste of the workman are peculiarly conspicuous, and which have exhibited the greatest success in resisting the concurrence of machinery, is divided into three sections:—1st. That which will be comprised within the exhibition building itself, as the manufacture of the tapestry and carpets of Aubusson and Beauvais, the making of designs and the preparation of the cards for the Jacquard loom, hand-lace making and embroidery, the making of artificial flowers and fruits; working in feathers, pearls, spun glass, &c.; fabrication of articles of clothing and small wares; working in the precious metals, and ornamental occupations, such as engraving, chasing, niello and damascene work, inlaying, incrustation; carving in wood, ivory, and metals; illumination and colouring on wood, stone, metal, paper, silk, and other materials; decorative painting on porcelain and panel; engraving on glass, gems, shell, copper, zinc, steel, stone, and wood; typographic and telegraphic composition; the polishing of lenses, and the construction of mathematical and philosophical instruments. 2nd. Works requiring the aid of fire, and which are to be grouped around sources of motive power in the park, such as the making of pottery, porcelain, glass; enamelling and filagree work, gold beating, works in the precious metals, in which the aid of fire is required; casting and working in bronze and other metals. 3rd. Agricultural and horticultural industries; photography, &c., in the park, or in places set apart for experiments and competition. The rearing of silkworms, the distillation of essences and perfumes, farming, and other employments occupying families or numbers of persons will each, as far as possible, have separate establishments for their accommodation, in order to exhibit them under their ordinary aspects.

The class of *non-European* occupations presents greater novelty and, at the same time, greater difficulty. The Commission has, however, received important tenders of assistance with respect to this class, which encourages the hope that a portion at least of the manual operations little known to the European world will be represented at the exhibition. In order to induce workmen and families from remote parts of the world to come to Paris and pursue their occupations during the time of the exhibition, and with the necessary submission to its rules, as well as to the habits of the European world, the Commission depends partly on the assistance of foreign commissions, and partly on the aid of missionaries and merchants. As regards the missionaries, it is expected that they will be able to induce some of their converts to accompany them to Paris, and also to superintend and arrange for their maintenance while here, either in the houses of the missions or in special apartments adapted to the habits and necessities of each family or party, and the Commission in all such cases is prepared to undertake all the costs. It is hoped that this arrangement will create within the limits of the exhibition a certain number of native groups, the study of whose habits, manners, and methods of working will be not only useful in an industrial point of view, but offer also valuable means of ethnological information. The same means of disposing of the productions of these strangers will be accorded as have already been mentioned with reference to European workmen.

The Commission hopes to present to the view of Europe, Laplanders making fishing-tackle; Ural Tartars employed in the preparation and ornamentation of skins and carpets; the Kabyles of Algeria making the glazed pottery of Bjerdjera, carvings in the wood of the fig-tree, ornaments in silver and coral, and carpets of Oran and other districts; natives of Morocco weaving silk, cotton, and woollen fabrics, making fez caps, saddles, and arms, and preparing shagreen; negroes of Soudan producing cotton cloth, morocco work, and pottery; the half-castes, or *Petits Blancs*, of the Isle of Bourbon making sacks for sugar and coffee; Anatolians weaving Smyrna carpets, silks, and cloth of gold; Syrians fabricating tissues and arms of Damascus, Aleppo, and Lebanon, mother-of-pearl work of Bethlehem, and gold work of Beyrout; Persians at work on Kurdistan carpets, silk embroidery, Kirman shawls, and silks and cottons of Yerd, enamelled tiles, and damascened arms; Indians weaving muslins, embroidering cashmeres, engraving ivory and wood, and twisting threads of gold into bracelets and other ornaments; Cambogians fabricating boxes and toys from sandal wood; Siamese carving rhinoceros horn; and, perhaps, Chinamen carving a nest of ivory balls; Japanese painting their incomparable lacquer wares; Mexicans turning their perfumed pottery; and red-skins composing head-dresses of feathers and bead-embroidered mocassins.

The above is a faithful sketch of subjects now under the consideration of the Imperial Commission, which calls upon all the civilised world to aid it in its labours. It is not to be supposed that the directors of the exhibition will accomplish all or half of that which it has sketched out, but its efforts will certainly not be fruitless, and there is little doubt that the Exhibition of 1867 will present an amount of variety and novelty which has never before been united on one spot.

The following are the amounts of space allotted to the various states taking part in the Exhibition:—

	Sq. Mètres.
France	64,056
Great Britain and Ireland	23,002
Prussia, Austria, and German States (each)	7,528
Belgium	7,249
Italy	3,888
United States of America	3,346
Russia	2,916
Switzerland	2,416
Sweden and Norway	2,091
Holland	1,998
Spain	1,994
Turkey	1,296
Portugal	1,134
Brazils	972
China and Japan, South America, Africa, and Oceana (each)	810
Denmark	650
Greece, Roumania, and Roman States (each)	648

Nearly the whole of one side of the building and of the park are devoted to France. Great Britain occupies that portion of the other side which is nearest the chief entrance, namely, that which faces the river; the amount of park space allotted to her is very large, and it is hoped that her model farms and cottages, agricultural machinery and produce will form a very attractive portion of the exhibition.

Commerce.

Statistics of Trade.—The total declared value of British and Irish produce and manufactures exported from the United Kingdom to foreign countries during the eight months ending August last amounted to £70,229,031, which, compared with the shipments in the same period of 1864, shows a decrease of £4,751,794, but against 1863 an augmentation of £10,873,321. The total value of produce and manufactures sent to British possessions in the same period was £32,171,665 in the eight months of the present year; £33,735,394 in 1864; and £30,396,141 in 1863. Our largest foreign customers have been the Hanse Towns, which took £9,523,749 worth of articles; the second on the list are the United States, including the Northern and Southern Atlantic ports, and the Pacific ports, whose imports from this country amounted, from last January to August, to £9,483,084. The third is France, whose purchases represent £5,901,486 ; the fourth Holland ; the fifth Italy, Egypt, and Brazil ; the sixth Turkey and China. Russia, including her Northern and Southern ports, did not receive quite so much as £2,000,000; and then follow Cuba and Porto Rico, Portugal, Spain, Mexico, New Granada, Chili, and the Argentine Confederation, &c. Among our colonies, India has taken £12,647,687, and Australia £8,297,240; next are our possessions in British North America, the Bermudas, the British West India Islands, British Guiana, British Honduras, and the Falkland Islands, whose gross total amounts to £5,063,323. The Cape of Good Hope occupies the fourth position on the list, and Singapore and the Eastern Straits the fifth.

THE SUGAR CROPS.—The accounts of the sugar crops in the West Indies are favourable. In Barbadoes, the continued prevalence of sultry weather during September had caused serious apprehensions in the minds of the growers as to the probable result of their operations; but the partial rains at the commencement of October, succeeded by copious showers, were sufficient to dispel all alarms, as they effected a complete change in the appearance and condition of the canes, and held out the most re-assuring promises of an abundant harvest. When canes are much advanced in the growth, slight showers are of little use, except as far as they give them a rather fresher appearance, and dispel that withered look which indicates deficiency of moisture; heavy and copious rains are needed to penetrate to the roots, and of these there has been of late an abundant supply. During the months of April, May, June, July, and August, the plantations had been subjected to an unusually trying ordeal in the condition of the weather; the unfavourable effect of the weather and of the atmosphere were most successfully encountered by those plantations which in the early season had been most plentifully manured. There was no apprehensions as to the existence of any disease in the canes, or any of those injuries, such as are caused by insects, notably the "borer;" but the ravages committed in some localities by the rats have been so serious as to induce planters to offer premiums for the production of rats' heads; but it seems that the depredations still continue. The crop of the island is estimated at about 47,000 hogsheads, but as there are still several acres of canes remaining to be cut, this estimate will probably be much exceeded. In Antigua the cane crop is highly promising, and a harvest more abundant than usual is expected. The improving quality of the cane-juice is the most remarkable feature in the accounts from the East, West, and Arabian coasts of Demerara, from Demerary River, and West Bank; but a great scarcity of labour, and also of coals, was experienced at more than one of these localities; and the crops at the Corentyne coast are rather deficient, owing to the drought in the early part of the year, the impeded drainage caused by heavy rains, and the ravages committed by the rats. In Jamaica the crops are forward, and there is an improvement in the sugar market.

RICE IN SIAM.—The rice of Siam is said to be some of the finest in the world, and its culture is capable of being carried on in that country to almost any extent. The following remarks on the subject are from the Commercial Report of Mr. Consul Knox, on the trade of Bang-Kok:—"The export of rice during the year 1864 amounted to 125,507 tons. The increased demand for this grain in China has already led to an extension of its cultivation, and will doubtless lead to more. The price at which it sells is ruled entirely by the demand in China, and the growers, who usually bring their own produce to market, must have realised very large profits during the last few years. The average price during the last year has been 300 per cent. higher than it was before the treaty of 1855. The land on which the seed is sown belongs to the King, and the rent charged is £2 10s. per acre. In good seasons the return from the seed is ninety fold. There is no system of irrigation, the natives trusting entirely to the rains or the overflowing of the rivers for the necessary moisture. Manure is not used, and the fields are seldom left fallow; the ground is therefore not so productive as it could be made, nor is new land brought into cultivation at the rate which might be expected. The extended cultivation has been merely on the land which was allowed to remain fallow. Thus, a person having, say ten acres, used formerly to cultivate five, and leave the rest fallow for that year; now he cultivates the whole ten yearly. The land in the vicinity of the rivers and canals is now mostly taken up, but there can be little doubt that owing to the increased fertility of the new land, it will be found profitable to cultivate it. The constant employment of the same ground, as above alluded to, will slso necessitate new land being brought into cultivation. Only one crop is sown in the year."

Colonies.

POST OFFICE SAVINGS BANKS IN VICTORIA.—The Post Office Savings Bank system came into operation in this colony on 11th September, when banks were opened in connection with the Post Office at Melbourne, Ballarat, Beechworth, Castlemaine, Geelong, Maryborough, Sandhurst, and Williamstown. Deposits of 6d. and upwards are received, but the deposits of any one person within the space of fourteen days must not exceed £50. The interest allowed on deposits will be at the rate of 4 per cent. per annum. The regulations for the Governor of the banks, made by the Governor-in-Council, pursuant to the requirements of the Post Office Law Amendment Act, provides the machinery for the transfer to the Post Office Savings Banks of the deposits of 1d. savings banks. The business in Melbourne is conducted in the new buildings at the corner of Elizabeth-street and Little Bourne-street, now rented by the postal department.

THE CO-OPERATIVE SYSTEM IN VICTORIA.—The Union Fisherman's Institution of this colony lately held their first anniversary. This association, it appears, was organised 12 months ago, in the face of many difficulties and disappointments. There are now about 90 members, and their fishing extends from Port Arlington to King's Island. During the year they sold about £5,000 worth of fish. The men get the full advantage of open markets in Ballarat and Melbourne, and each receives the full benefit of his own efforts. They are paid at least 25 per cent. more than under the old system; the middlemen are put aside, and the fishermen and public are the gainers. The boats, nets, &c., are so improved as to be worth at least £3,000.

THE EXTRACTION OF GOLD AND SILVER FROM THEIR ORES.—A new machine for this purpose has recently been tried at Sydney. It is called "Wheeler's Patent Amalgamator and Concentrator," and the model now in use consists of a round cast-iron pan, four feet in diameter and twenty-two inches deep, furnished with a set of grooved plates in the bottom. Inside this pan there is a revolving disc, or muller, with grooved plates attached, corresponding with those at the bottom of the pan. These two surfaces are so constructed that the ore has to pass between them, by which means it is ground into an impalpable pulp; the pan is charged with half a ton weight of ore and sixty pounds of quicksilver, and driven by steam power. Beneath the pan there is a steam jacket through which steam constantly passes, keeping the quicksilver in a heated state throughout the process; to this action the advantage possessed by this machine over others is attributable. The quicksilver upon being heated boils up through the pulp; upon arriving at the surface, it condenses, and descends by its own superior gravity,—continuing the above operation throughout the process. The heating of the quicksilver and the precious metals with which it continually comes into contact, gives them a greater affinity for each other than they possess when cold,—thus accounting for the large quantity of gold taken up by this machine. But the application of heat in this form possesses other advantages:—it drives off the sulphur existing in the form of mundic, leaving the gold and silver in a condition to combine with the quicksilver, which in the ordinary process they will not do. It is alleged that in some instances Wheeler's Amalgamator has extracted 95 per cent. of the gold from mundic ores which have refused to yield any result under the ordinary process; and that it has, at the same time, taken out 65 per cent. of the silver—it being well known that this metal is not obtainable by the usual process of amalgamation. The ore being sufficiently ground and amalgamated is discharged into a second pan, where, by the assistance of cold water, the amalgam rapidly settles, and the tailings are discharged, when the precious metals are treated in the usual way. The inventor states that a set of these pans, consisting of two, and one amalgamator, will work one ton of ore at a charge, requiring from two to four hours, including charge and discharge. The model now at work is a twentieth of the size of the machines about to be constructed. Since the model machine has been put up in Sydney, several experiments have been made with the auriferous and argentiferous ores of the colony, with very satisfactory results.

Publications Issued.

The Magnetic Purification of River Water, and the Report of the Sewage Committee of 1864. By Thomas Spencer, F.C.S. (*Stanford.*)—This pamphlet was published in consequence of a measure introduced to the House of Commons last session by Lord Robert Montagu, to prevent the influx of town drainage into rivers, on the plea that the water of such rivers cannot thereafter be purified, which however has been withdrawn. The plan recommended by the author is the use of the magnetic oxide of iron, which is said to be of great efficacy in purifying water which has been infected by town sewage.

Notes.

The Raphael Cartoons at South Kensington.—On Saturday last a deputation of trades delegates and others appointed at a recent meeting held at Cambridge-hall, had an interview, by appointment, with Earl Granville. The delegates were Messrs. Mickeson (hatters), Richardson (boot and shoe makers), Shuff (coach painters), Cole (curriers), Preece (upholsterers), Cochrane (house-painters), with Messrs. J. Baxter Langley, R. M. Morrell, F. R. Bertolacci, E. Giles, Barnesley, Howker, Horton, and others. Mr. Morrell read a memorial setting forth that the working classes felt that in removing the Raphael cartoons to South Kensington the same regulations and facilities for viewing them should have been given as when they were at Hampton Court, and they claimed, therefore, that the gallery containing them should be opened on Sunday afternoon. It further reminded the Government that the working classes had not forgotten that the Sheepshanks collection of pictures had been accepted together with the donor's wish that they should be open to inspection on Sunday afternoon, a fact which appeared to have been forgotten by the Government, since no effort had been made to carry it out. The memorial was signed by over 100 delegates. Messrs. Morrell, Langley, Cochrane, Mickeson, Bertolacci, &c., supported the request, urging the large numbers of persons to be found on Sunday evenings at Highbury-barn, Cremorne, and similar places, statistics of which were quoted. It was shown that publicans found it worth their while to go to great expense in fitting up museums in their houses, which proved great attractions; that recently published statistics prove the large numbers who do not go to church or chapel, and for whom it was necessary to make intellectual provision; that the Government had recently opened the National Gallery as well as the Botanic Gardens in Dublin, and had thus set aside the vote of the House of Commons of some years since; and that to shut the cartoons up after so many years of their being open was a retrograde movement, seeing that the principle was the same although the place was changed, and in this battle of the rights of the working classes against prejudice every inch of ground would be maintained. Earl Granville assured the deputation of the correctness of their belief in his agreement with them on the broad question, and he concurred that the cartoons having been exhibited on Sunday at Hampton Court placed their exhibition at South Kensington on a different footing from that of the Museum itself; though, no doubt, the deputation thought that after getting the cartoon gallery open the other parts would soon follow. The National Gallery of Dublin was opened at the express desire of the people, who were, perhaps, more unanimous on the question than was the case with the people of London. The deputation were quite right in bringing the Sheepshanks bequest to his notice, and he thanked them for doing so; he should, however, like to take a few days before giving a reply on the cartoons question. He expressed the gratification afforded him by the interview. In a letter dated dated Tuesday last, his lordship says:—"It is not my intention to make any alteration in the existing rules of South Kensington."

Railway Extension and Labourers' Dwellings.—The intended terminal station of the Midland Railway Company, between St. Pancras-road and Skinner-street, and abutting on the Euston-road, to the eastward of King's-cross Railway-station, will involve the removal of the houses on the north side of Euston-road between Skinner-street and the Great Northern Railway-station (including St. Luke's Church); the houses on the west side of St. Pancras-road from Weston-street to Brewer-street, and from Brewer-street to Welford-street, the whole of Brewer-street, part of Brill-row and Brill-mews, the whole of Perry-street, Smith-street, Weston-street, Hertford-street, and the several alleys, yards, and courts within that area. The number of inhabitants, who are principally of the poorer classes, that will be thus displaced will exceed 20,000 persons. Such will be the effect of the erection of only one of the many great railway works now being constructed or in contemplation in the metropolis, on the already limited accommodation for the working classes.

The late West London Exhibition.—It is stated that two of the guarantors of the West London Exhibition—Messrs. Harris Heal, of Tottenham-court-road, and J. Hansler, of Lincoln's-inn, have examined and certified to the accuracy of the accounts, and have authorised the guarantors being called upon to the full amount of the money for which they guaranteed. The debts resulting from the exhibition amount to about £1,300, and the sum guaranteed between £1,300 and £1,400. The committee, it is stated, will lose no time in collecting the money and meeting all demands.

Glycerine for Moistening Modelling-Clay.—It is stated in *Cosmos* that some experiments have been made on the use of glycerine instead of water for moistening modelling-clay. Clay well dried, and afterwards rendered plastic by admixture with glycerine, is said to have been kept in a warm room for two months, at the end of which time its plasticity had not at all diminished. Clay rendered plastic by glycerine appears to be capable of being used over and over again, just like wax, with the advantage of always retaining the same consistence and degree of plasticity, being neither hardened by cold nor softened by heat.

Female Education.—Mrs. Arnott, wife of Dr. Neill Arnott, has signified her wish to place £1,000 at the disposal of the Council of the Queen's College, London, for the two-fold purpose of encouraging the study of natural philosophy as part of a girl's education, and perpetuating the memory and influence of her husband's writings. It is proposed to apply £400 of this sum to the foundation of a scholarship, giving a free education in the college for one year, and the right of free attendance at the classes in natural philosophy for life. Physical science will form the main subject-matter of the examination, and the scholarship will be open to all candidates under the age of eighteen. The interest of the remaining £600 will be applied in purchasing apparatus, and augumenting the stipend of the Professor of Natural Philosophy. It is said that a like liberal gift has been offered to the Ladies' College in Bedford-square.

MEETINGS FOR THE ENSUING WEEK.

Mon. ...Royal Geographical, 8½.
Medical, 8. Special General Meeting for Consideration of the Laws of the Society.
Actuaries, 7. Mr. W. M. Makeham, "On the Principles to be observed in the Construction of Mortality Tables."
Society of Arts, 8. Cantor Lectures. Mr. G. W. Hastings, LL.D., "On the Effects of the Discovery of the Precious Metals on the Ancient Civilization of the Mediterranean." (Lecture I.)
Tues. ...Zoological, 8½.
Civil Engineers, 8. Renewed Discussion upon Sir Charles Bright's paper, "The Telegraph to India, and its Extension to Australia and China."
Wed. ...Society of Arts, 8. Mr. William Hawes, "On the Proposed Purchase of Railways by the Government."

Patents.

From Commissioners of Patents Journal, November 17*th*.

Grants of Provisional Protection.

Artificial eyes—2813—A. Boissonneau.
Billiard tables, cushions for—2874—G. A. Smith.
Blast furnaces, separating dust from the gases evolved from—2885—C. Cochrane.
Blind rollers, suspending blinds from—2732—S. P. Matthews.
Boiler feeder, self-acting—2849—P. B. O'Neill.
Boots and shoes—2861—R. Flude.
Boots and shoes—2877—C. Mole.
Bricks, artificial stone, and marble—2867—D. Barker.
Carpet bags, frames and fastenings of—2850—J. King and A. Watson.
Carpet, doubled face—2792—A. Braquenié.
Cloths, machinery for measuring—2862—W. Hebdon.
Cylinders, combined vertical generating steam in—2776—T.B.Jordan.
Copper ore, manufacture of copper from—2838—J. B. Elkington.
Counters for indicating the distances vehicles travel—2736—M. Julien.
Croquet, articles used in in-door—2821—H. Jones.
Driving bands, &c., fasteners for—2802—T. F. Cashin and J. Felix.
Dyeing and printing, colouring matter for—2825—L. Schad.
Economising heat and curing smoky chimneys—2822—W. E. Gedge.
Electric telegraphs—2762—H. Wilde.
Envelopes—2794—R. Girdwood.
Envelope machines—1896—A. V. Newton.
Fibrous materials, preparing, &c.—2866—M. J. Roberts.
Files, renewing the teeth of—2887—J. B. O. Lassus.
Fire-arms—2800—C. Chattaway.
Gases, generating—2833—J. Webster.
Gases, inflammable—2719—I. Baggs.
Gas, purifying—2818—C. H. Wood and E. L. Barret.
Goffering and plaiting machines—2823—W. B. West.
Greenhouses—2684—T. H. P. Dennis.
Gum, artificial—2810—J. Sellars.
Invalids, facilitating the walking of—2873—F. G. Bennett.
Iron and steel—2835—H. Bessemer.
Iron vessels, sheathing—2832—E. Clark.
Knickerbockers or leggings—2788—J. Stanley.
Lace, &c., dressing—2827—W. E. Dobson.
Lathe chucks—2782—J. Buckingham.
Leaf, treating or curing the—2855—F. Campbell.
Locks—2852—W. Gardner.
Locks—2879—J. A. Rainé.
Magnesium, lamps for the combustion of—2786—H. Larkin.
Manure, artificial—2830—G. Bartlett.
Metallic pipes, &c., manufacture of—2804—A. Deslandes.
Millstones, mounting and driving—2839—R. Smith.
Mining picks—2796—W. E. Newton.
Needle—2766—L. Bennett.
Non-conducting composition—2853—J. Thys.
Paraffin oil, lamps for burning—2787—J. and J. Hinks.
Peat, drying—2824—M. Campbell, A. C. P. Coote, and J. C. A. H. Wolfram.
Penholder—2834—R. C. Lilly.
Petroleum, apparatus for burning—2829—L. Pebeyre.
Projectiles—2831—C. F. Henwood.
Pulley blocks—2884—T. Westley and W. Bibby.
Railway carriages, buffing and drawing apparatus for—2840—G. Wilson and W. K. Hydes.
Railway engines and vehicles, wheels for—2860—R. C. Mansell.
Railway trains, communication between the passengers, guard, and engine driver of—2845—H. Radcliffe.
Railways, "crossings" to be employed on—2760—J. Johnson.
Railways, permanent way of, and carriages for—2227—J. C. Green.
Railways, promoting adhesion of locomotive wheels to rails of—2798—D. P. G. Matthews.
Rifled fire-arms, preparing charges for—2856—J. Whitworth.
Roadways, construction of—2756—T. R. Crampton.
Sewage water, deodorization of—2808—H. Y. D. Scott.
Ships, propelling—2641—G. Rosselet.
Signals, transmitting and receiving—2841—A. H. Brandon.
Silk, &c., machinery for reeling—2826—E. Rushton.
Solid, waxy, or fatty substances, purification of—2768—S. Sequelin.
Spikes—2806—M. Bayliss.
Splint for surgical purposes—2871—H. Hides.
Steam engines, lubricating the cylinders of—2881—N. Beard and J. Maiden.
Telegraph wires, submarine electric—2765—W. Smith.
Textile fabrics, printing and dyeing—2859—A. Paraf.
Travelling bags, fastening for—2814—L. Pféiffer.
Tyres, casting hoops of steel for—2886—W. D. Allen.
Windows, raising and lowering—2816—J. K. Farnworth.
Yarns, sizing—2883—J. Eastwood.

Inventions with Complete Specifications Filed.

Cabinet furniture—2901—D. Slater.
Nail machines—2921—H. C. Davis.
Needles, apparatus for threading—2924—H. A. Bonneville.
Pliant fabrics, inserting glass in—2880—J. H. Johnson.

Patents Sealed.

1396. W. Eddington.
1398. J. Armstrong.
1404. J. Shand.
1409. R. Muller, A. T. Weld, and J. F. Powell.
1414. A. Hett.
1419. T. Beanland.
1420. J. Dale and A. Paraf.
1425. J. Ramsbottom.
1437. G. Bray.
1447. J. A. Heinrich.
1461. T. Bissell.
1468. H. Moseley.
1477. W. Smith.
1480. J. Hibell.
1527. C. Taylor.
1570. H. B. Fox.
2130. J. Stevenson.

From Commissioners of Patents Journal, November 21*st*.

Patents Sealed.

1427. D. Welsh.
1429. D. Law and J. Bennet.
1430. R. A. Brooman.
1432. W. Madders.
1448. R. Canham.
1449. G. Elliot and R. P. Clark.
1450. C. B. Spaeth.
1452. C. Frazer.
1453. S. Sequelin.
1462. L. Diele.
1463. G. G. Bussey.
1488. L. Martin.
1501. F. Richmond, H. Chandler, and J. G. Richmond
1516. J. Nuttall.
1604. J. Griffiths.
1647. J. H. Johnson.
1719. W. E. Newton.
1786. J. H. Johnson.
1890. C. H. Simpson.
2378. H. Venables.
2406. J. Goulding.
2517. W. E. Newton.

Patents on which the Stamp Duty of £50 has been Paid.

3105. J. Chalmers.
3068. W. H. Andrew.
3081. W. H. James.
3096. E. P. Houghton.
3104. H. J. F. Marmet.
3124. W. Bottomley.

Patent on which the Stamp Duty of £100 has been Paid.

2581. M.A.Muir & J. McIlwham.
2625. W. Marshall.
2630. T. S. Cressy.
2638. W. Lea.
2640. H. Jordan.